Distribution of the stonefly *Isogenoides zionensis* Hanson, 1949 (Plecoptera: Perlodidae) in Canada

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The species *Isogenoides zionensis* was first described by Hanson (1949) based on male specimens collected in Zion National Park, Utah, United States of America. A revision of the genus *Isogenoides* Klapálek, 1912 was conducted by Ricker (1952), who provided a detailed key and description of seven species but did not include *Isogenoides zionensis* Hanson, 1949. Ricker (1964) reported the presence of *I. zionensis* from the Northwest Territories of Canada based on specimens present in the Canadian National Collection of Insects, Arachnids and Nematodes (CNCI; Ottawa, Ontario). Baumann (1973) described the female, nymphs, and eggs of *I. zionensis* in his study of stoneflies in Utah. Baumann *et al.* (1977), in their study of the stoneflies of the Rocky Mountains, record the distribution of *I. zionensis* from Colorado, New Mexico, and Utah, United States of America. Sander and Stewart (2005a) revised the genus *Isogenoides* but unfortunately did not include specimens from the CNCI. Sander and Stewart (2005a) suggested that the specimens they examined from British Columbia in the National Museum of Natural History (NMNH) and from the Northwest Territories in Brigham Young University (BYU) were suspect and possibly mislabelled. Stewart and Oswood (2006) and Kondratieff *et al.* (2019) record the presence of *I. zionensis* in Canada only from the Northwest Territories, based on Sander and Stewart (2005a).

Recent work examining Plecoptera specimens in the CNCI, the University of Guelph (UOG) Barcode of Life Data System, and the Royal British Columbia Museum (RBCM)(Burton 2019a, 2019b) turned up a number of specimens of *I. zionensis*, which supports the range distribution of this species in Canada.

Specimens of *Isogenoides* from the CNCI and RBCM were examined to verify their species identification. Binomial names on the specimen labels were compared to distribution records listed in the online Plecoptera Species File (DeWalt *et al.* 2021). All specimens were examined using a Leica MZ6 stereomicroscope (Leica, Wetzlar, Germany) and any *I. zionensis* specimens were databased and deposited in the CNCI. Photos of selected specimens were taken using a Tucsen USB 2.0 H Series camera (Tucsen, Gaishan Town, Fuzhou, Fujian, Peoples' Republic of China) attached to a Leica MZ6 stereomicroscope using Windows Live Photo Gallery software (Microsoft, Redmond, Washington, United States of America).

Detailed collection data and photographs for specimens are available in the CNCI online database (https://cnc.agr.gc.ca/taxonomy/SpecSearchD15.php?taxon=597260).

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Collection locality data were mapped to show updated distribution patterns using decimal GPS coordinates and plotted using an Excel Mapcite software program (https://www.mapcite.com [accessed 02 May 2021]). Specimen localities are indicated on the distribution maps in Figures 1 and 2 as follows: Records from the CNCI and RBCM specimens are indicated by black pins and previously published locations are indicated by red pins. The distribution maps include only literature records where specific collection data was given, or a map was provided. In the distribution listings, specimens recorded for the first time from a province, territory, or state are indicated in **bold** text. Previously published jurisdictional records that were not listed in the online Plecoptera Species File (http://plecoptera.speciesfile.org/HomePage/Plecoptera/HomePage.aspx) are indicated in ***italic bold*** text.

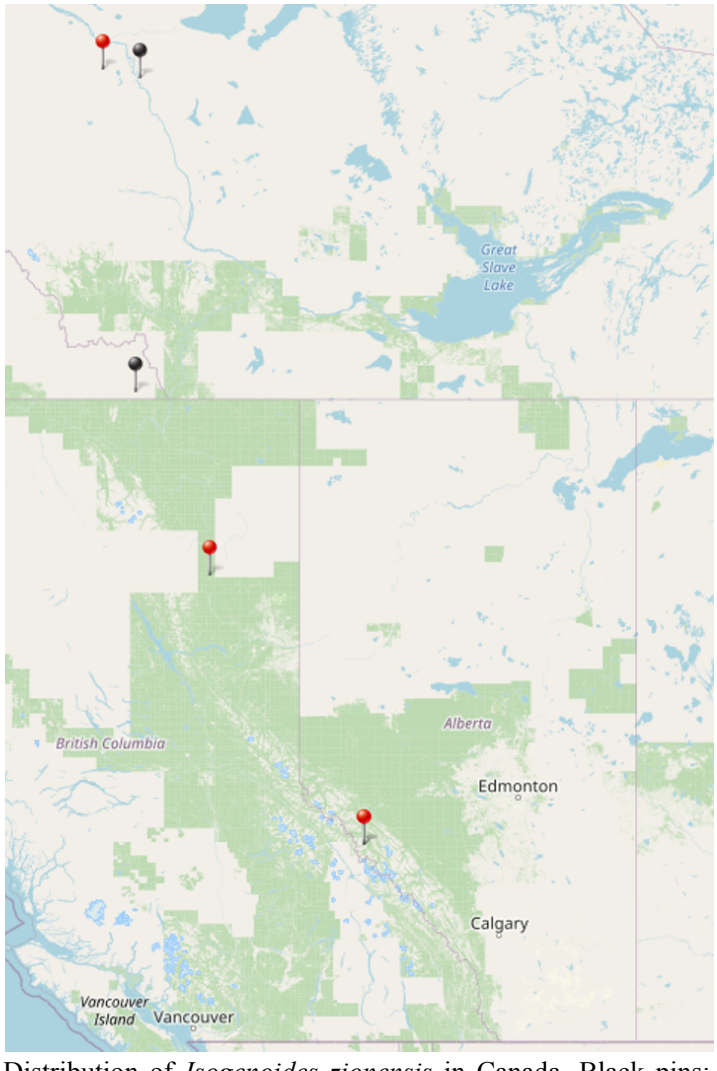

Figure 1. Distribution of *Isogenoides zionensis* in Canada. Black pins: specimens held at CNCI and RBCM; Red pins: records reported in the literature (Donald and Anderson 1980; Sander and Stewart 2005a).

The systematic arrangement used is that of Illies (1966) and DeWalt *et al*. (2021). The morphological structure terminology used is that of Sander and Stewart (2005a). Abbreviations of Canadian provinces and American states are from the Canadian Endangered Species Conservation Council (2016) and Stark *et al*. (1986).

Figure 2. Distribution of *Isogenoides zionensis* in the United States of America. Black pin: specimens held at CNCI; Red pins: records reported in the literature (Sander and Stewart 2005a; Cary and Jacobi 2008).

***Isogenoides zionensis* Hanson, Zion Springfly**

http://plecoptera.speciesfile.org/Common/basic/Taxa.aspx?TaxonNameID=1157523

Isogenoides zionensis Hanson, 1949. Holotype ♂, Virgin River, Zion National Park, UT (NMNH)

Isogenoides zionensis: Donald and Anderson 1980: 753–758

Isogenoides zionensis: Sander and Stewart 2005a: 310–314

Isogenoides zionensis: Sander and Stewart 2005b: 21–32

Isogenoides zionensis: Stewart and Oswood 2006: 186, 212

Isogenoides zionensis: Cary and Jacobi 2008: 142

Additional synonyms are given by Sander and Stewart (2005a) and on the Plecoptera Species File (http://plecoptera.speciesfile.org/HomePage/Plecoptera/HomePage.aspx).

Distribution. CAN: ***AB***, BC, NT, **YK** (Figure 1). USA: AZ, CO, NM, UT (Figure 2) (Ricker 1964; Donald and Anderson 1980; Sander and Stewart 2005a; Cary and Jacobi 2008).

Material examined. CAN: NT, **YK**. USA: UT.

Northwest Territories:

○Keele River at McKenzie River**,** 64.416898, –124.797474, 1♂, 1♀, 26.vi.1953, (P.M. Mann) (CNCI).

Yukon:

○Beaver River, 60.07809, –124.87712, 3♂ (Figure 3), 1♀ (Figure 4), 23.vi.2014, (S.G. Cannings) (CNCI) (RBCM) (**New territorial record**).

Utah:

○Virgin River, Zion National Park, 37.251203, –112.958485, Paratype ♂, 22.vi.1942 (C.P. Alexander) (CNCI).

Figure 3. Lateral view of epiproct of male *Isogenoides zionensis* (Beaver River, Yukon)

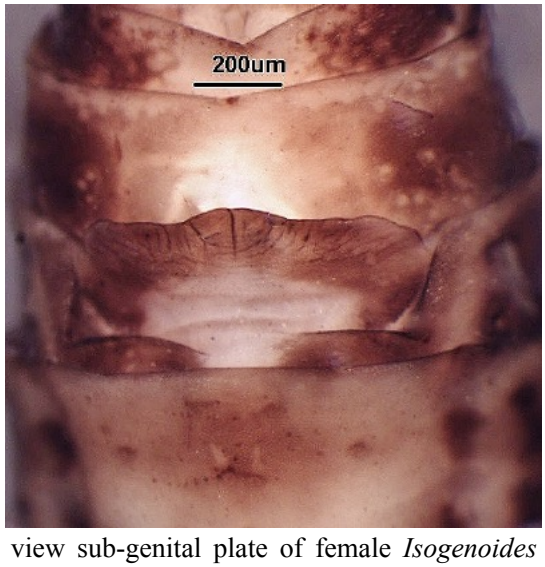

Figure 4. Ventral view sub-genital plate of female *Isogenoides zionensis* (Beaver River, Yukon)

The previously published accounts of *I. zionensis* from Alberta (Donald and Anderson 1980), the discovery of an *I. zionensis* population in the Rocky Mountains of the Yukon, and re-examination of specimens in the CNCI from the

Northwest Territories and Utah add validity to the location data provided for specimens from British Columbia (NMNH) and specimens from the Northwest Territories (BYU) that have been questioned in the past (Sander and Stewart 2005a). Updated distributional information in the present study also illustrates the importance of maintaining archived specimens in natural history collections in order to provide baseline information for biodiversity studies.

The records shown on the distribution maps (Figures 1 and 2) indicate large distances among known populations in Canada and between those in Canada and the United States of America. The Yukon population is approximately halfway (250 km) between both the Northwest Territories population and the British Columbia population, and the Alberta population is more than 800 km from the populations in British Columbia (Figure 1) and more than 2000 km from the closest other recorded populations in Utah (Figure 2). Additional collecting in the Rocky Mountains of Canada, Idaho, Montana, and Wyoming should discover populations of *I. zionensis* that connect the northern Canadian populations with the populations in the Rocky Mountains of Canada and the United States of America.

Reports by Baumann *et al*. (1977), Stark *et al.* (1986), and Stewart and Oswood (2006) of *I. zionensis* from Alaska are not supported by any known museum, personal holding, or other published records (Sander and Stewart 2005b), indicating that Alaska should be removed from the distribution range of this species.

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